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Fourth Edition

Sams Teach Yourself

SQL®

in 24 Hours

SAMS

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Introduction

Welcome to the world of relational databases and SQL! This book is written for those self-motivated individuals out there who would like to get an edge on relational database technology by learning the Structured Query Language—SQL. This book was written primarily for those with very little or no experience with relational database management systems using SQL. This book also applies to those who have some experience with relational databases but need to learn how to navigate within the database, issue queries against the database, build database structures, manipulate data in the database, and more. This book is not geared toward individuals with significant relational database experience who have been using SQL on a regular basis.

What This Book Intends to Accomplish

This book was written for individuals with little or no experience using SQL or those who have used a relational database, but their tasks have been very limited within the realm of SQL. Keeping this thought in mind, it should be noted up front that this book is strictly a learning mechanism, and one in which we present the material from ground zero and provide examples and exercises with which to begin to apply the material covered. This book is not a complete SQL reference and should not be relied on as a sole reference of SQL. However, this book combined with a complete SQL command reference could serve as a complete solution source to all of your SQL needs.

What We Added to This Edition

This edition contains the same content and format as the first through third editions. We have been through the entire book, searching for the little things that could be improved to produce a better edition. We have also added concepts and commands from the new SQL standard, SQL:2003, to bring this book up to date, making it more complete and applicable to today's SQL user. The most important addition was the use of MySQL for hands-on exercises. By using an open source database such as MySQL, all readers have equal opportunity for participation in hands-on exercises.

What You Need

You might be wondering, what do I need to make this book work for me? Theoretically, you should be able to pick up this book, study the material for the current hour, study the examples, and either write out the exercises or run them on a relational database server. However, it would be to your benefit to have access to a relational database system to which to apply the material in each lesson. The relational database to which you have access is not a major factor because SQL is the standard language for all relational databases. Some database systems that you can use include Oracle, Sybase, Informix, Microsoft SQL Server, Microsoft Access, MySQL, and dBASE.

Conventions Used in This Book

For the most part, we have tried to keep conventions in this book as simple as possible.

Many new terms are printed in italics.

In the listings, all code that you type in (input) appears in `boldface monospace`. Output appears in standard `monospace`. Any code that is serving as a placeholder appears in *`italic monospace`*.

SQL code and keywords have been placed in uppercase for your convenience and general consistency. For example:

```
SELECT * FROM PRODUCTS_TBL;

PROD_ID    PROD_DESC                        COST
---------- ------------------------------- -----
11235      WITCHES COSTUME                 29.99
222        PLASTIC PUMPKIN 18 INCH          7.75
13         FALSE PARAFFIN TEETH             1.1
90         LIGHTED LANTERNS                14.5
15         ASSORTED COSTUMES               10
9          CANDY CORN                       1.35
6          PUMPKIN CANDY                    1.45
87         PLASTIC SPIDERS                  1.05
119        ASSORTED MASKS                   4.95

9 rows selected.
```

The following special design features enhance the text:

There are syntax boxes to draw your attention to the syntax of the commands discussed during each hour.

```
SELECT [ ALL ¦ * ¦ DISTINCT COLUMN1, COLUMN2 ]
FROM TABLE [ , TABLE2 ];
```

Notes are provided to expand on the material covered in each hour of the book.

By the Way

Cautions are provided to warn the reader about "disasters" that could occur and certain precautions that should be taken.

Watch Out!

Tips are also given to supplement the material covered during appropriate hours of study.

Did you Know?

ANSI SQL and Vendor Implementations

One thing that is difficult about writing a book like this on standard SQL is that although there is an ANSI standard for SQL, each database vendor has its own implementation of SQL. With each implementation come variations from the actual standard, enhancements to the standard, and even missing elements from the standard.

The expected question is, "Because there is an ANSI standard for SQL, what is so difficult about teaching standard SQL?" The answer to this question begins with the statement that ANSI SQL is just that: a standard. ANSI SQL is not an actual language. To teach you SQL, we had to come up with examples and exercises that involve using one or more implementations of SQL. Because each vendor has its own implementation with its own specifications for the language of SQL, these variations, if not handled properly in this book, could actually cause confusion concerning the syntax of various SQL commands. Therefore, we have tried to stay as close to the ANSI standard as possible, foremost discussing the ANSI standard and then showing examples from different implementations that are very close, if not the same, as the exact syntax that ANSI prescribes.

We have, however, accompanied examples of variations among implementations with notes for reminders and tips on what to watch out for. Just remember this: Each implementation differs slightly from other implementations. The most important thing is that you understand the underlying concepts of SQL and its commands. Although slight variations do exist, SQL is basically the same across the board and is very portable from database to database, regardless of the particular implementation.

Understanding the Examples and Exercises

We have chosen to use MySQL for most of the examples in this book due to its high compliance to the ANSI standard; however, we have also shown examples from Oracle, Sybase, Microsoft SQL Server, and dBASE.

The use of MySQL for hands-on exercises was chosen so that all readers may participate, with minimal confusion in converting SQL syntax into the proper syntax of the database each reader is using. MySQL was chosen for exercises because it is an open source database (free), it is easy to install, and its syntax is very similar to that of the ANSI Standard. Additionally, MySQL is compatible with most operating system platforms.

In Appendix B, “Using MySQL for Exercises,” we show you how to obtain and install MySQL. After it is installed on your computer, MySQL can be used for most of the exercises in this book. Unfortunately, because MySQL is not fully ANSI SQL compliant, MySQL exercises are not available for every subject.

As stated, some differences in the exact syntax exist among implementations of SQL. For example, if you attempt to execute some examples in this book, you might have to make minor modifications to fit the exact syntax of the implementation that you are using. We have tried to keep all the examples compliant with the standard; however, we have intentionally shown you some examples that are not exactly compliant. The basic structure for all the commands is the same. To learn SQL, you have to start with an implementation using practical examples. For hands-on practice, we use MySQL. If you have access to another database implementation such as Oracle, we encourage its use for hands-on exercises. You should be able to emulate the database and examples used in this book without much difficulty. Any adjustments that you might have to make to the examples in this book to fit your implementation exactly will only help you to better understand the syntax and features of your implementation.

Good luck!

HOUR 3

Managing Database Objects

In this hour, you learn about database objects: what they are, how they act, how they are stored, and how they relate to one another. Database objects are the underlying backbone of the relational database. These *objects* are logical units within the database that are used to store information and are referred to as the *back-end database*. The majority of the instruction during this hour revolves around the table, but keep in mind that there are other database objects, many of which are discussed in later hours of study.

The highlights of this hour include:

- **An introduction to database objects**
- **An introduction to the schema**
- **An introduction to the table**
- **A discussion of the nature and attributes of tables**
- **Examples for the creation and manipulation of tables**
- **A discussion of table storage options**
- **Concepts on referential integrity and data consistency**

What Are Database Objects?

A *database object* is any defined object in a database that is used to store or reference data. Some examples of database objects include tables, views, clusters, sequences, indexes, and synonyms. The table is this hour's focus because it is the primary and simplest form of data storage in a relational database.

What Is a Schema?

A *schema* is a collection of database objects (as far as this hour is concerned—tables) associated with one particular database username. This username is called the *schema owner*, or the owner of the related group of objects. You may have one or multiple schemas in a database. The user is only associated with the schema of the same name and often the terms will be used interchangeably. Basically, any user who creates an object has just created it in her own schema unless she specifically instructs it to be created in another one. So, based on a user's privileges within the database, the user has control over objects that are created, manipulated, and deleted. A schema can consist of a single table and has no limits to the number of objects that it may contain, unless restricted by a specific database implementation.

Say you have been issued a database username and password by the database administrator. Your username is `USER1`. Suppose you log on to the database and then create a table called `EMPLOYEE_TBL`. According to the database, your table's actual name is `USER1.EMPLOYEE_TBL`. The schema name for that table is `USER1`, which is also the owner of that table. You have just created the first table of a schema.

The good thing about schemas is that when you access a table that you own (in your own schema), you do not have to refer to the schema name. For instance, you could refer to your table as either one of the following:

```
EMPLOYEE_TBL
USER1.EMPLOYEE_TBL
```

The first option is preferred because it requires fewer keystrokes. If another user were to query one of your tables, the user would have to specify the schema, as follows:

```
USER1.EMPLOYEE_TBL
```

In Hour 20, "Creating and Using Views and Synonyms," you learn about the distribution of permissions so that other users can access your tables. You also learn about synonyms, which allow you to give a table another name so you do not have to specify the schema name when accessing a table. Figure 3.1 illustrates two schemas in a relational database.

There are, in Figure 3.1, two user accounts in the database that own tables: USER1 and USER2. Each user account has its own schema. Some examples for how the two users can access their own tables and tables owned by the other user follow:

USER1 accesses own TABLE1:	TABLE1
USER1 accesses own TEST:	TEST
USER1 accesses USER2's TABLE10:	USER2.TABLE10
USER1 accesses USER2's TEST:	USER2.TEST

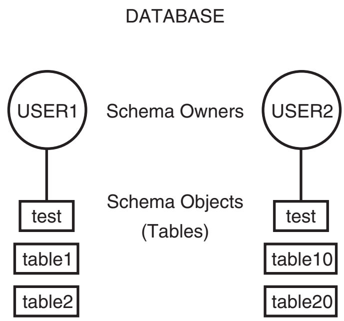


FIGURE 3.1
Schemas in a database.

In this example, both users have a table called TEST. Tables can have the same names in a database as long as they belong to different schemas. If you look at it this way, table names are always unique in a database because the schema owner is actually part of the table name. For instance, USER1.TEST is a different table than USER2.TEST. If you do not specify a schema with the table name when accessing tables in a database, the database server looks for a table that you own by default. That is, if USER1 tries to access TEST, the database server looks for a USER1-owned table named TEST before it looks for other objects owned by USER1, such as synonyms to tables in another schema. Hour 21, "Working with the System Catalog," helps you fully understand how synonyms work. You must be careful to understand the distinction between objects in your own schema and those objects in another schema. If you do not provide a schema when performing operations that alter the table, such as a DROP command, the database will assume that you mean a table in your own schema. This could possibly lead to you unintentionally dropping the wrong object. So you must always pay careful attention as to which user you are currently logged into the database with.

By the Way

> Every database server has rules concerning how you can name objects and elements of objects, such as field names. You must check your particular implementation for the exact naming conventions or rules.

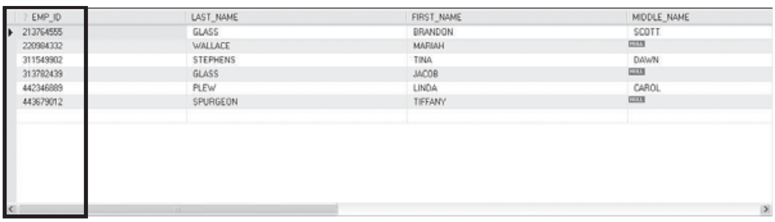
A Table: The Primary Storage for Data

The table is the primary storage object for data in a relational database. In its simplest form, a table consists of row(s) and column(s), both of which hold the data. A table takes up physical space in a database and can be permanent or temporary.

Columns

A field, also called a *column* in a relational database, is part of a table that is assigned a specific data type; a field should be named to correspond with the type of data that will be entered into that column. Columns can be specified as `NULL` or `NOT NULL`, meaning that if a column is `NOT NULL`, something must be entered. If a column is specified as `NULL`, nothing has to be entered.

Every database table must consist of at least one column. Columns are those elements within a table that hold specific types of data, such as a person's name or address. For example, a valid column in a customer table might be the customer's name. Figure 3.2 illustrates a column in a table.



EMP_ID	LAST_NAME	FIRST_NAME	MIDDLE_NAME
213764555	GLASS	BRANDON	SCOTT
220984332	WALLACE	MARIAH	NULL
311549902	STEPHENS	TINA	DAWN
313782439	GLASS	JACOB	NULL
442346889	PLEW	LINDA	CAROL
443679012	SPURGEON	TIFFANY	NULL

FIGURE 3.2
An Example of a Column

Generally, an object name must be one continuous string and can be limited to the number of characters used according to each implementation of SQL. It is typical to use underscores with names to provide separation between characters. For example, a column for the customer's name can be named `CUSTOMER_NAME` instead of `CUSTOMERNAME`.

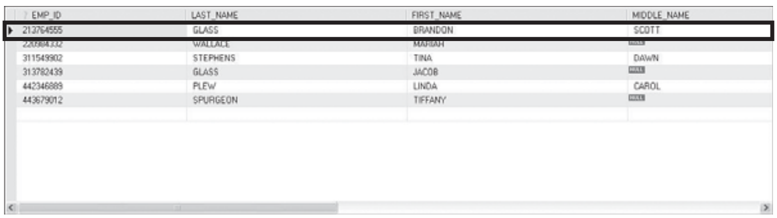
Additionally, data can be stored as either uppercase or lowercase for character-defined fields. The case that you use for data is simply a matter of preference, which should be based on how the data will be used. In many cases, data is stored in uppercase for simplicity and consistency. However, if data is stored in different case types throughout the database (uppercase, lowercase, and mixed case), functions can be applied to convert the data to either uppercase or lowercase if needed. These functions will be covered in Hour 11, "Restructuring the Appearance of Data."

By the Way

Be sure to check your implementation for rules when naming objects and other database elements. Often database administrators will adopt a *naming convention* that explains how to name the objects within the database so you can easily discern how they are used.

Rows

A *row* is a record of data in a database table. For example, a row of data in a customer table might consist of a particular customer's identification number, name, address, phone number, fax number, and so on. A row is comprised of fields that contain data from one record in a table. A table can contain as little as one row of data and up to as many as millions of rows of data or records. Figure 3.3 illustrates a row within a table.



EMP_ID	LAST_NAME	FIRST_NAME	MIDDLE_NAME
213764555	GLASS	BRANDON	SCOTT
220984332	WALLACE	MARIAH	NULL
311549902	STEPHENS	TINA	DAWN
313782439	GLASS	JACOB	NULL
442346889	PLEW	LINDA	CAROL
443679012	SPURGEON	TIFFANY	NULL

FIGURE 3.3
Example of a Table Row.

The `CREATE TABLE` Statement

The `CREATE TABLE` statement in SQL is used to create a table. Although the very act of creating a table is quite simple, much time and effort should be put into planning table structures before the actual execution of the `CREATE TABLE` statement. Carefully planning your table structure before implementation will save you from having to reconfigure things after they are in production.

Some elementary questions need to be answered when creating a table:

- What type of data will be entered into the table?
- What will be the table's name?
- What column(s) will compose the primary key?

- What names shall be given to the columns (fields)?
- What data type will be assigned to each column?
- What will be the allocated length for each column?
- Which columns in a table can be left blank?

After these questions are answered, the actual CREATE TABLE statement is simple.

The basic syntax to create a table is as follows:

```
CREATE TABLE table_name
( field1  data_type  [ not null ],
  field2  data_type  [ not null ],
  field3  data_type  [ not null ],
  field4  data_type  [ not null ],
  field5  data_type  [ not null ] );
```

A semicolon is the last character in the previous statement. Most SQL implementations have some character that terminates a statement or submits a statement to the database server. Oracle and MySQL use the semicolon. Transact-SQL has no such requirement. This book uses the semicolon.

By the Way

> In this hour's examples, we use the popular data types CHAR (constant-length character), VARCHAR (variable-length character), NUMBER (numeric values, decimal and non-decimal), and DATE (date and time values).

Create a table called EMPLOYEE_TBL in the following example:

```
CREATE TABLE EMPLOYEE_TBL
(EMP_ID         CHAR(9)        NOT NULL,
EMP_NAME        VARCHAR (40)   NOT NULL,
EMP_ST_ADDR     VARCHAR (20)   NOT NULL,
EMP_CITY        VARCHAR (15)   NOT NULL,
EMP_ST          CHAR(2)        NOT NULL,
EMP_ZIP         INTEGER(5)      NOT NULL,
EMP_PHONE       INTEGER(10)     NULL,
EMP_PAGER       INTEGER(10)     NULL);
```

Eight different columns make up this table. Notice the use of the underscore character to break the column names up into what appears to be separate words (EMPLOYEE ID is stored as EMP_ID). This is a technique that is used to make a table or column name more readable. Each column has been assigned a specific data type and length, and by using the NULL/NOT NULL constraint, you have specified which columns require values for every row of data in the table. The EMP_PHONE is defined as NULL, meaning that NULL values are allowed in this column because there might be individuals without a telephone number. The information concerning each column is separated by a comma, with parentheses surrounding all columns (a left parenthesis before the first column and a right parenthesis following the information on the last column).

Each record, or row of data, in this table would consist of the following:

```
EMP_ID, EMP_NAME, EMP_ST_ADDR, EMP_CITY, EMP_ST, EMP_ZIP, EMP_PHONE, EMP_PAGER
```

In this table, each field is a column. The column EMP_ID could consist of one employee's identification number or many employees' identification numbers, depending on the requirements of a database query or transactions. The column is a vertical entity in a table, whereas a row of data is a horizontal entity.

> **By the Way**
>
> NULL is a default attribute for a column; therefore, it does not have to be entered in the CREATE TABLE statement. NOT NULL must always be specified.

Naming Conventions

When selecting names for objects, specifically tables and columns, the name should reflect the data that is to be stored. For example, the name for a table pertaining to employee information could be named EMPLOYEE_TBL. Names for columns should follow the same logic. When storing an employee's phone number, an obvious name for that column would be PHONE_NUMBER.

> **By the Way**
>
> Check your particular implementation for name length limits and characters that are allowed; they could differ from implementation to implementation.

The ALTER TABLE Command

A table can be modified through the use of the ALTER TABLE command after that table's creation. You can add column(s), drop column(s), change column definitions, add and drop constraints, and, in some implementations, modify table STORAGE values. The standard syntax for the ALTER TABLE command follows:

```
alter table table_name [modify] [column column_name][datatype¦null not null]
[restrict¦cascade]
                       [drop]   [constraint constraint_name]
                       [add]    [column] column definition
```

Modifying Elements of a Table

The *attributes* of a column refer to the rules and behavior of data in a column. You can modify the attributes of a column with the ALTER TABLE command. The word *attributes* here refers to the following:

- The data type of a column
- The length, precision, or scale of a column
- Whether the column can contain NULL values

The following example uses the ALTER TABLE command on EMPLOYEE_TBL to modify the attributes of the column EMP_ID:

```
ALTER TABLE EMPLOYEE_TBL MODIFY
EMP_ID VARCHAR(10);

Table altered.
```

The column was already defined as data type VARCHAR (a varying-length character), but you increased the maximum length from 9 to 10.

Adding Mandatory Columns to a Table

One of the basic rules for adding columns to an existing table is that the column you are adding cannot be defined as NOT NULL if data currently exists in the table. NOT NULL means that a column must contain some value for every row of data in the table. So, if you are adding a column defined as NOT NULL, you are contradicting the NOT NULL constraint right off the bat if the preexisting rows of data in the table do not have values for the new column.

There is, however, a way to add a mandatory column to a table:

1. Add the column and define it as NULL (the column does not have to contain a value).
2. Insert a value into the new column for every row of data in the table.
3. After ensuring that the column contains a value for every row of data in the table, you can alter the table to change the column's attribute to NOT NULL.

Adding Auto-Incrementing Columns to a Table

Sometimes it is necessary to create a column that auto-increments itself in order to give a unique sequence number for a particular row. This could be done for many reasons, such as not having a natural key for the data or you would like to use a unique sequence number to sort the data. Creating an auto-incrementing column is generally quite easy. In MySQL the implementation provides the SERIAL method to produce a truly unique value for the table. Following is an example:

```
CREATE TABLE TEST_INCREMENT(
        ID          SERIAL,
        TEST_NAME   VARCHAR(20));

INSERT INTO TEST_INCREMENT(TEST_NAME)
VALUES ('FRED'),('JOE'),('MIKE'),('TED');

SELECT * FROM TEST_INCREMENT;

¦ ID ¦     TEST_NAME ¦
¦  1 ¦     FRED      ¦
¦  2 ¦     JOE       ¦
¦  3 ¦     MIKE      ¦
¦  4 ¦     TED       ¦
```

Modifying Columns

There are many things to take into consideration when modifying existing columns of a table. Following are some common rules for modifying columns:

- The length of a column can be increased to the maximum length of the given data type.
- The length of a column can be decreased only if the largest value for that column in the table is less than or equal to the new length of the column.
- The number of digits for a number data type can always be increased.
- The number of digits for a number data type can be decreased only if the value with the most number of digits for that column is less than or equal to the new number of digits specified for the column.
- The number of decimal places for a number data type can either be increased or decreased.
- The data type of a column can normally be changed.

Some implementations may actually restrict you from using certain ALTER TABLE options. For example, you might not be allowed to drop columns from a table. To do this, you would have to drop the table itself, and then rebuild the table with the desired columns. You could run into problems by dropping a column in one table that is dependent on a column in another table, or a column that is referenced by a column in another table. Be sure to refer to your specific implementation documentation.

Watch Out!

> Take heed when altering and dropping tables. If logical or typing mistakes are made when issuing these statements, important data can be lost.

Creating a Table from an Existing Table

A copy of an existing table can be created using a combination of the CREATE TABLE statement and the SELECT statement. The new table has the same column definitions. Any or all columns can be selected. New columns that are created via functions or a combination of columns automatically assume the size necessary to hold the data. The basic syntax for creating a table from another table is as follows:

```
create table new_table_name as
select [ *¦column1, column2 ]
from table_name
[ where ]
```

Notice some new keywords in the syntax, particularly the SELECT keyword. SELECT is a database query and is discussed in more detail in Chapter 7, "Introduction to Database Query." However, it is important to know that you can create a table based on the results from a query.

First, we do a simple query to view the data in the PRODUCTS_TBL table.

Watch Out!

> You will create the tables that you see in these examples at the end of this hour in the "Exercises" section. In Hour 5, "Manipulating Data," you will populate the tables you create in this hour with data.

```
select * from products_tbl;

PROD_ID    PROD_DESC                       COST
---------- ------------------------------ ------
11235      WITCHES COSTUME                29.99
222        PLASTIC PUMPKIN 18 INCH         7.75
13         FALSE PARAFFIN TEETH            1.1
90         LIGHTED LANTERNS               14.5
15         ASSORTED COSTUMES              10
9          CANDY CORN                      1.35
6          PUMPKIN CANDY                   1.45
87         PLASTIC SPIDERS                 1.05
119        ASSORTED MASKS                  4.95
```

Watch Out!

> SELECT * selects data from all fields in the given table. The * represents a complete row of data, or record, in the table.

Next, create a table called PRODUCTS_TMP based on the previous query:

```
create table products_tmp as
select * from products_tbl;

Table created.
```

Now, if you run a query on the PRODUCTS_TMP table, your results appear the same as if you had selected data from the original table.

```
select *
from products_tmp;

PROD_ID    PROD_DESC                      COST
---------- ---------------------------- ------
11235      WITCHES COSTUME               29.99
222        PLASTIC PUMPKIN 18 INCH        7.75
13         FALSE PARAFFIN TEETH           1.1
90         LIGHTED LANTERNS              14.5
15         ASSORTED COSTUMES             10
9          CANDY CORN                     1.35
6          PUMPKIN CANDY                  1.45
87         PLASTIC SPIDERS                1.05
119        ASSORTED MASKS                 4.95
```

By the Way

When creating a table from an existing table, the new table takes on the same STORAGE attributes as the original table.

Dropping Tables

Dropping a table is actually one of the easiest things to do. When the RESTRICT option is used and the table is referenced by a view or constraint, the DROP statement returns an error. When the CASCADE option is used, the drop succeeds and all referencing views and constraints are dropped. The syntax to drop a table follows:

```
drop table table_name [ restrict¦cascade ]
```

In the following example, you drop the table that you just created:

```
drop table products.tmp;

Table dropped.
```

Watch Out!

Whenever dropping a table, be sure to specify the schema name or owner of the table before submitting your command. You could drop the incorrect table. If you have access to multiple user accounts, ensure that you are connected to the database through the correct user account before dropping tables.

Integrity Constraints

Integrity constraints are used to ensure accuracy and consistency of data in a relational database. Data integrity is handled in a relational database through the concept of referential integrity. Many types of integrity constraints play a role in referential integrity (RI).

Primary Key Constraints

Primary key is the term used to identify one or more columns in a table that make a row of data unique. Although the primary key typically consists of one column in a table, more than one column can comprise the primary key. For example, either the employee's Social Security number or an assigned employee identification number is the logical primary key for an employee table. The objective is for every record to have a unique primary key or value for the employee's identification number. Because there is probably no need to have more than one record for each employee in an employee table, the employee identification number makes a logical primary key. The primary key is assigned at table creation.

The following example identifies the `EMP_ID` column as the `PRIMARY KEY` for the `EMPLOYEES` table:

```
CREATE TABLE EMPLOYEE_TBL
(EMP_ID        CHAR(9)        NOT NULL PRIMARY KEY,
EMP_NAME       VARCHAR (40)   NOT NULL,
EMP_ST_ADDR    VARCHAR (20)   NOT NULL,
EMP_CITY       VARCHAR (15)   NOT NULL,
EMP_ST         CHAR(2)        NOT NULL,
EMP_ZIP        INTEGER(5)     NOT NULL,
EMP_PHONE      INTEGER(10)    NULL,
EMP_PAGER      INTEGER(10)    NULL);
```

This method of defining a primary key is accomplished during table creation. The primary key in this case is an implied constraint. You can also specify a primary key explicitly as a constraint when setting up a table, as follows:

```
CREATE TABLE EMPLOYEE_TBL
(EMP_ID        CHAR(9)        NOT NULL,
EMP_NAME       VARCHAR (40)   NOT NULL,
EMP_ST_ADDR    VARCHAR (20)   NOT NULL,
EMP_CITY       VARCHAR (15)   NOT NULL,
EMP_ST         CHAR(2)        NOT NULL,
EMP_ZIP        INTEGER(5)     NOT NULL,
EMP_PHONE      INTEGER(10)    NULL,
EMP_PAGER      INTEGER(10)    NULL,
PRIMARY KEY (EMP_ID));
```

The primary key constraint in this example is defined after the column comma list in the CREATE TABLE statement.

A primary key that consists of more than one column can be defined by either of the following methods:

```
CREATE TABLE PRODUCTS
(PROD_ID       VARCHAR2(10)     NOT NULL,
 VEND_ID       VARCHAR2(10)     NOT NULL,
 PRODUCT       VARCHAR2(30)     NOT NULL,
 COST          NUMBER(8,2)      NOT NULL,
PRIMARY KEY (PROD_ID, VEND_ID));

ALTER TABLE PRODUCTS
ADD CONSTRAINT PRODUCTS_PK PRIMARY KEY (PROD_ID, VEND_ID);
```

Unique Constraints

A *unique column constraint* in a table is similar to a primary key in that the value in that column for every row of data in the table must have a unique value. Although a primary key constraint is placed on one column, you can place a unique constraint on another column even though it is not actually for use as the primary key.

Study the following example:

```
CREATE TABLE EMPLOYEE_TBL
(EMP_ID        CHAR(9)         NOT NULL     PRIMARY KEY,
EMP_NAME       VARCHAR (40)    NOT NULL,
EMP_ST_ADDR    VARCHAR (20)    NOT NULL,
EMP_CITY       VARCHAR (15)    NOT NULL,
EMP_ST         CHAR(2)         NOT NULL,
EMP_ZIP        INTEGER(5)      NOT NULL,
EMP_PHONE      INTEGER(10)     NULL         UNIQUE,
EMP_PAGER      INTEGER(10)     NULL);
```

The primary key in this example is EMP_ID, meaning that the employee identification number is the column that is used to ensure that every record in the table is unique. The primary key is a column that is normally referenced in queries, particularly to join tables. The column EMP_PHONE has been designated as a UNIQUE value, meaning that no two employees can have the same telephone number. There is not a lot of difference between the two, except that the primary key is used to provide an order to data in a table and, in the same respect, join related tables.

Foreign Key Constraints

A *foreign key* is a column in a child table that references a primary key in the parent table. A *foreign key constraint* is the main mechanism used to enforce referential integrity between tables in a relational database. A column defined as a foreign key is used to reference a column defined as a primary key in another table.

Study the creation of the foreign key in the following example:

```
CREATE TABLE EMPLOYEE_PAY_TBL
(EMP_ID            CHAR(9)         NOT NULL,
POSITION            VARCHAR2(15)   NOT NULL,
DATE_HIRE           DATE           NULL,
PAY_RATE            NUMBER(4,2)    NOT NULL,
DATE_LAST_RAISE     DATE           NULL,
CONSTRAINT EMP_ID_FK FOREIGN KEY (EMP_ID) REFERENCES EMPLOYEE_TBL (EMP_ID));
```

The EMP_ID column in this example has been designated as the foreign key for the EMPLOYEE_PAY_TBL table. This foreign key, as you can see, references the EMP_ID column in the EMPLOYEE_TBL table. This foreign key ensures that for every EMP_ID in the EMPLOYEE_PAY_TBL, there is a corresponding EMP_ID in the EMPLOYEE_TBL. This is called a *parent/child relationship*. The parent table is the EMPLOYEE_TBL table, and the child table is the EMPLOYEE_PAY_TBL table. Study Figure 3.4 for a better understanding of the parent table/child table relationship.

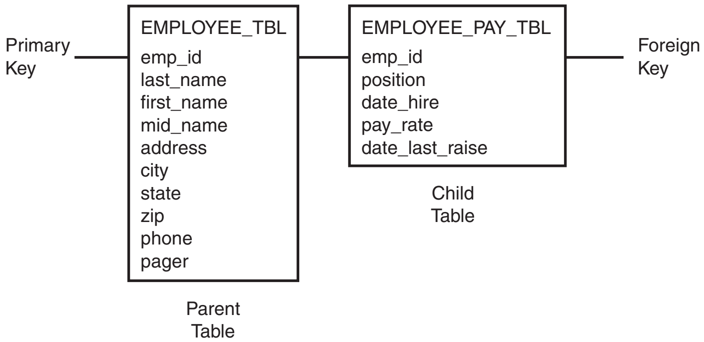


FIGURE 3.4 The parent/child table relationship.

In this figure, the EMP_ID column in the child table references the EMP_ID column in the parent table. For a value to be inserted for EMP_ID in the child table, a value for EMP_ID in the parent table must first exist. Likewise, for a value to be removed for EMP_ID in the parent table, all corresponding values for EMP_ID must first be removed from the child table. This is how referential integrity works.

A foreign key can be added to a table using the ALTER TABLE command, as shown in the following example:

```
alter table employee_pay_tbl
add constraint id_fk foreign key (emp_id)
references employee_tbl (emp_id);
```

By the Way

> The options available with the ALTER TABLE command differ among different implementations of SQL, particularly when dealing with constraints. In addition, the actual use and definitions of constraints also vary, but the concept of referential integrity should be the same with all relational databases.

NOT NULL Constraints

Previous examples use the keywords NULL and NOT NULL listed on the same line as each column and after the data type. NOT NULL is a constraint that you can place on a table's column. This constraint disallows the entrance of NULL values into a column; in other words, data is required in a NOT NULL column for each row of data in the table. NULL is generally the default for a column if NOT NULL is not specified, allowing NULL values in a column.

Check Constraints

Check (CHK) constraints can be utilized to check the validity of data entered into particular table columns. Check constraints are used to provide back-end database edits, although edits are commonly found in the front-end application as well. General edits restrict values that can be entered into columns or objects, whether within the database itself or on a front-end application. The check constraint is a way of providing another protective layer for the data.

The following example illustrates the use of a check constraint:

```
CREATE TABLE EMPLOYEE_TBL
(EMP_ID        CHAR(9)        NOT NULL,
EMP_NAME       VARCHAR2(40)   NOT NULL,
EMP_ST_ADDR    VARCHAR2(20)   NOT NULL,
EMP_CITY       VARCHAR2(15)   NOT NULL,
EMP_ST         CHAR(2)        NOT NULL,
EMP_ZIP        NUMBER(5)      NOT NULL,
EMP_PHONE      NUMBER(10)     NULL,
EMP_PAGER      NUMBER(10)     NULL),
PRIMARY KEY (EMP_ID),
CONSTRAINT CHK_EMP_ZIP CHECK ( EMP_ZIP = '46234');
```

The check constraint in this table has been placed on the EMP_ZIP column, ensuring that all employees entered into this table have a ZIP code of '46234'. Perhaps that is a little restricting. Nevertheless, you can see how it works.

If you wanted to use a check constraint to verify that the ZIP code is within a list of values, your constraint definition could look like the following:

```
CONSTRAINT CHK_EMP_ZIP CHECK ( EMP_ZIP in ('46234','46227','46745') );
```

If there is a minimum pay rate that can be designated for an employee, you could have a constraint that looks like the following:

```
CREATE TABLE EMPLOYEE_PAY_TBL
(EMP_ID            CHAR(9)        NOT NULL,
POSITION           VARCHAR2(15)   NOT NULL,
DATE_HIRE          DATE           NULL,
PAY_RATE           NUMBER(4,2)    NOT NULL,
DATE_LAST_RAISE    DATE           NULL,
CONSTRAINT  EMP_ID_FK FOREIGN KEY (EMP_ID) REFERENCES EMPLOYEE_TBL (EMP_ID),
CONSTRAINT CHK_PAY CHECK ( PAY_RATE > 12.50 ) );
```

In this example, any employee entered in this table must be paid more than $12.50 an hour. You can use just about any condition in a check constraint, as you can with a SQL query. You learn more about these conditions in Hours 5 and 7.

Dropping Constraints

Any constraint that you have defined can be dropped using the `ALTER TABLE` command with the `DROP CONSTRAINT` option. For example, to drop the primary key constraint in the `EMPLOYEES` table, you can use the following command:

```
ALTER TABLE EMPLOYEES DROP CONSTRAINT EMPLOYEES_PK;

Table altered.
```

Some implementations might provide shortcuts for dropping certain constraints. For example, to drop the primary key constraint for a table in MySQL, you can use the following command:

```
ALTER TABLE EMPLOYEES DROP PRIMARY KEY;

Table altered.
```

By the Way

> Some implementations allow you to disable constraints. Instead of permanently dropping a constraint from the database you might want to temporarily disable the constraint, and then enable it later.

Summary

You have learned a little about database objects in general, but have specifically learned about the table. The table is the simplest form of data storage in a relational database. Tables contain groups of logical information, such as employee, customer, or product information. A table is composed of various columns, with each column having attributes; those attributes mainly consist of data types and constraints, such as `NOT NULL` values, primary keys, foreign keys, and unique values.

You learned the `CREATE TABLE` command and options, such as storage parameters, that might be available with this command. You have also learned how to modify the structure of existing tables using the `ALTER TABLE` command. Although the process of managing database tables might not be the most basic process in SQL, it is our philosophy that if you first learn the structure and nature of tables, you more easily grasp the concept of accessing the tables, whether through data manipulation operations or database queries. In later hours, you learn about the management of other objects in SQL, such as indexes on tables and views.

Q&A

Q. ***When I name a table that I am creating, is it necessary to use a suffix such as*** `_TBL`***?***

A. Absolutely not. You do not have to use anything. For example, a table to hold employee information could be named similar to the following, or anything else that would refer to what type of data is to be stored in that particular table:

```
EMPLOYEE
EMP_TBL
EMPLOYEE_TBL
EMPLOYEE_TABLE
WORKER
```

Q. ***Why is it so important to use the schema name when dropping a table?***

A. Here's a true story about a new DBA that dropped a table: A programmer had created a table under his schema with the same name as a production table. That particular programmer left the company. The programmer's database account was being deleted from the database, but the `DROP USER` statement returned an error due to the fact that outstanding objects were owned by the programmer. After some investigation, it was determined that the programmer's table was not needed, so a `DROP TABLE` statement was issued.

It worked like a charm—but the problem was that the DBA was logged in as the production schema when the `DROP TABLE` statement was issued. The DBA should have specified a schema name, or owner, for the table to be dropped. Yes, the wrong table in the wrong schema was dropped. It took approximately eight hours to restore the production database.

Workshop

The following workshop is composed of a series of quiz questions and practical exercises. The quiz questions are designed to test your overall understanding of the current material. The practical exercises are intended to afford you the opportunity to apply the concepts discussed during the current hour, as well as build upon the knowledge acquired in previous hours of study. Please take time to complete the quiz questions and exercises before continuing. Refer to Appendix C, "Answers to Quizzes and Exercises," for answers.

Quiz

1. Will the following CREATE TABLE statement work? If not, what needs to be done to correct the problem(s)?

```
Create table EMPLOYEE_TABLE as:
   ( ssn              number(9)       not null,
    last_name        varchar2(20)    not null,
    first_name       varchar2(20)    not null,
    middle_name      varchar2(20)    not null,
    st address       varchar2(30)    not null,
    city             char(20)        not null,
    state            char(2)          not null,
    zip              number(4)       not null,
    date hired       date);
```

2. Can you drop a column from a table?

3. What statement would you issue in order to create a primary key constraint on the preceding EMPLOYEE_TABLE?

4. What statement would you issue on the preceding EMPLOYEE_TABLE to allow the MIDDLE_NAME column to accept NULL values?

5. What statement would you use to restrict the people added into the preceding EMPLOYEE_TABLE to only reside in the state of New York ('NY')?

6. What statement would you use to add an auto-incrementing column called EMPID to the preceding EMPLOYEE_TABLE?

Exercises

1. Bring up a command prompt and use the following syntax to log onto your local MySQL instance, replacing *username* with your username and *password* with your password. Ensure that you do not leave a space between -p and your password.

```
Mysql  -h localhost -u username  -ppassword
```

2. At the mysql> command prompt, enter the following command to tell MySQL that you want to use the database you created previously:

```
use learnsql;
```

3. Now, go to Appendix D, "CREATE TABLE Statements for Book Examples," to get the DDL for the tables used in this book. At the mysql> prompt, enter each CREATE TABLE statement. Be sure to include a semicolon at the end of each CREATE TABLE statement. The tables that you create will be used throughout the book.

4. At the mysql> prompt, enter the following command to get a list of your tables:

```
show tables;
```

5. At the mysql> prompt, use the DESCRIBE command (desc for short) to list the columns and their attributes for each one of the tables you created. For example:

```
describe employee_tbl;
describe employee_pay_tbl;
```

6. If you have any errors or typos, simply re-create the appropriate table(s). If the table was successfully created, but has typos (perhaps you did not properly define a column or forgot a column), drop the table, and issue the CREATE TABLE command again. The syntax of the DROP TABLE command is as follows:

```
drop table orders_tbl;
```

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